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HIGHWAY RESEARCH REPORT

DEVELOPMENT OF A RAPID DRYING TRAFFIC PAINT SYSTEM USING MICRO-WAVE ENERGY

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January, 1968

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

MATERIALS AND RESEARCH DEPARTMENT

RESEARCH REPORT

NO. M & R 635154

Prepared in Cooperation with the U.S. Department of Transportation, Bureau of Public Roads

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

MATERIALS AND RESEARCH DEPARTMENT
5900 FOLSOM BLVD., SACRAMENTO 95819



Final Research
Report
M & R No. 635154

January, 1968

Mr. J. A. Legarra
State Highway Engineer

Dear Sir:

Submitted herewith is a research report titled:

DEVELOPMENT OF A
RAPID DRYING TRAFFIC PAINT SYSTEM,
USING MICROWAVE ENERGY

D. L. Spellman
Principal Investigator

H. A. Rooney
Co-Investigator

Very truly yours,



JOHN L. BEATON

Materials and Research Engineer

REFERENCE: Spellman, D. L., Rooney, H. A., "Development of a Rapid Drying Traffic Paint System, Using Microwave Energy", State of California, Department of Public Works, Division of Highways, Materials and Research Department, Research Report No. 635154, January, 1968.

ABSTRACT: This report describes the results of a research contract awarded an electronics company to develop a suitable traffic paint and to design equipment which would dry the traffic paint to a state of "no pick-up" in approximately one second by the application of micro-wave energy. After several months of investigation the contracting company concluded it was not technically feasible to achieve the objectives within the contract because of the difficulty in generating a sufficiently high energy intensity at the dielectric interface of the paint and pavement surfaces.

KEY WORDS: Paints, Traffic Paints, Drying, Microwaves, Electronic Means, Traffic Marking Materials.

DEVELOPMENT OF A
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INTRODUCTION AND CONCLUSIONS

In metropolitan areas, it has been increasingly difficult and dangerous to do centerline striping of streets and highways with conventional air drying traffic paints and the operation seriously interferes with the flow of traffic. At 77°F and above, it takes about 15 minutes for 15 mil wet film thickness of a typical air drying traffic paint to reach a condition of "dry to no pick-up", by traffic. At temperatures down to 45 - 50°F, the dry time for the same paint may approach 45 minutes or more.

In order to protect a freshly painted traffic stripe until it has reached the stage of "no pick-up" it is necessary to control traffic by placing cones along the stripe. This procedure not only interferes with the normal flow of traffic, but is a safety hazard as well as costly.

This research project was conceived with the objective of determining if a traffic paint might be developed that could be dried to the state of no pick-up in approximately one second by the application of microwave energy to the freshly applied paint. A contract was awarded Litton Industries, specialists in microwave

equipment development, to design a paint and microwave equipment to obtain the objective described above. After a program of investigation covering about 17 months, Litton Industries concluded that it was not technically feasible to achieve the objectives of the contract, and recommended that the effort be terminated. It was considered impractical to design equipment powerful enough to overcome the difficulty of generating a sufficiently high field intensity at the dielectric interface. A copy of the final report prepared by Litton Industries, on Contract MR-137 is attached, which describes the work in detail.

DISCUSSION

This final report describes the results of the research project currently numbered 635154, initiated as a contract with Litton Industries, to develop a fast drying traffic paint, and a machine to apply and cure it.

Traffic striping has ordinarily required the use of cones to control traffic until the paint has "dried" or "set" to "no pick-up". The ultimate goal of the project was to achieve a "dry to no pick-up" condition in one second by curing the paint with microwave energy applied through an antenna. Litton Industries, Atherton Division, was contacted for discussion since they were known to have experience with equipment that might be built for this purpose. Preliminary discussions were held between the representatives of Litton and the Division of Highways. The project was judged feasible based on preliminary testing with mock-up equipment when paints containing di-polar solvents and applied over a polystyrene insulator responded to microwave energy.

A proposal was written up in cooperation with Litton Industries and submitted to the Bureau of Public Roads for approval as a federally financed project. Numerous problems arose concerning such things as maximum daily amounts that could be paid individuals acting as consultants, allowable costs, fixed

fees, manufacturing overhead, administrative expense, patents and future manufacture of paint equipment. Litton was to develop a prototype, self-powered microwave unit, to apply and cure the paint, and develop a suitable paint.

An acceptable contract was finally signed (MR 137) and work continued. Costs of certain equipment already acquired by Litton in the meantime were transferred to the project and payment made. The total estimated cost of the project including those to the State for administration and field trials was \$165,000, of which a maximum of \$148,000 was allotted to Litton Industries. Since the project was not successful and work was terminated by the State, the total cost will be about \$115,000.

The project got off to a good start. The Litton representatives were confident that they could develop the "drying" equipment and believed the special paint could be developed by the paint company they hired for this part of the work. Solvent type paints were being dried in lab tests in about 10 seconds with small, low power equipment. Fabrication proceeded on the trailer unit which included microwave generators, a 15 KW generator, an air compressor, and control panel, all mounted on a four-wheel low bed running gear. Large radar energy power supplies for the magnetrons were designed and build to operate at a frequency of 915 mc. Special antennas were built that could radiate the power in accordance with FCC regulations. Frequent inspections made during the period June 1964 to February 1965, during which discussions were held regarding equipment progress and paint formulation. A few new paints were tested for drying under mock-up

conditions. About February 1965, the Litton people informed the State that a frequency of 2450 mc would be more efficient. Since this would likely involve an extension in contract time, a formal request was prepared and approved to extend the contract time and change the frequency to 2450 mc. It was claimed that the higher frequency would make the "distance to paint film" less critical and would make it possible to raise the illuminator higher off the pavement and lessen the chance of contact between it and any obstruction on the roadway. Also, since the higher frequency was more efficient, less power would be required.

Other types of paints were tried, including water-based paints and epoxy types. Solvent based paints were too "explosive". Violent bubbling occurred as the solvents were boiled causing a very rough and porous paint film.

As previously stated in this report, all laboratory tests performed at Litton's which indicated paint could be dried rapidly by microwave energy, were performed where the paint was applied to paper resting on a polystyrene insulator.

At a meeting on September 21, 1965, Litton arranged a test in which paint was applied directly to a concrete block and microwave energy applied. The paint would not cure (dry) because the microwave energy was dissipated at the paint-concrete interface. When the same paint was applied over a microwave insulator (polystyrene), the paint cured in 45 seconds.

As a result of this meeting on September 21, 1965, and a subsequent meeting on October 8, 1965, Litton recommended this

project be terminated because the obstacles presented by energy losses in the concrete were too great to overcome in a practical manner.